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Review Article

Anti-Inflammatory Potential of Plants Found in Konkan Region: A Review

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ABSTRACT

Although inflammation is a basic physiological reaction to damaging stimuli, many non-communicable diseases are caused by its chronic manifestation. Even though traditional medications like corticosteroids and NSAIDs work well, their long-term usage is frequently limited by serious side effects, which calls for the investigation of safer phytochemical substitutes. The Konkan region, which is located in the Western Ghats of India, a hotspot for biodiversity, has a rich history of ethnomedicinal plants that are used to treat inflammatory diseases. By combining the pharmacological and ethnobotanical profiles of 45 local medicinal plants in this area, this review fills the current knowledge gap. This work integrates traditional indigenous knowledge with contemporary scientific validation by investigating the functions of bioactive chemicals, specifically flavonoids, alkaloids, and terpenoids, in influencing important pathways like NF-κB and COX/LOX inhibition. Ultimately, this review highlights the therapeutic potential of Konkan flora as a sustainable resource for drug discovery and emphasizes the importance of conserving these species for future clinical applications.

INTRODUCTION:

Inflammation is a natural protective response of the body that helps defend tissues against infections, injuries, and other harmful stimuli. It occurs through the coordinated action of immune cells and the release of cytokines and other chemical mediators, which work together to remove the cause of injury and promote tissue repair. Acute inflammation is usually a short-term and beneficial process that plays an important role in healing. However, when inflammation continues for a prolonged period or becomes uncontrolled, it may lead to tissue damage and contribute to the onset and progression of several chronic diseases. Conditions such as rheumatoid arthritis, asthma, cardiovascular diseases, neurodegenerative disorders, diabetes, and cancer have all been associated with persistent or

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dysregulated inflammation.[1] The World Health Organization (WHO) recognizes inflammatory and immune-mediated disorders as an important contributor to the global burden of non-communicable diseases. The occurrence of these disorders has been increasing steadily in both developed and developing countries, highlighting the growing need for effective strategies to prevent and manage inflammation-related conditions.[2]

Conventional treatments, including non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and immunosuppressive agents, are widely used for the management of inflammatory disorders. These medications help control inflammation by inhibiting cyclooxygenase (COX) enzymes, reducing excessive immune responses, and regulating various pro-inflammatory signalling pathways. Although these drugs are generally effective in relieving inflammation and associated symptoms, their prolonged use may lead to several unwanted effects, such as gastrointestinal irritation, kidney and liver toxicity, and an increased risk of cardiovascular complications.[3]. These limitations highlight the need for alternative therapeutic approaches that can provide effective control of inflammation while offering greater safety and suitability for long-term use.

In view of these limitations, medicinal plants and their naturally occurring bioactive compounds have gained considerable interest as potential sources of anti-inflammatory agents. Various phytochemicals, including flavonoids, alkaloids, terpenoids, tannins, and saponins, have been reported to possess anti-inflammatory properties. These compounds may act through several pathways, such as inhibiting COX and lipoxygenase (LOX enzymes), reducing the production of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6, suppressing the NF-κB signaling pathway, and regulating oxidative stress by controlling reactive oxygen species (ROS). [4-5] Among these phytochemicals, flavonoids have received considerable attention because of their potential to reduce inflammation associated with oxidative stress. Studies suggest that flavonoids may help regulate the activation of dendritic cells and inhibit the NF-κB signaling pathway, thereby reducing the release of inflammatory mediators..[6]

Importantly, the development of several widely used medicines has been inspired by compounds obtained from medicinal plants. For example, aspirin has its roots in plant-derived salicylates, while colchicine was obtained from (*Colchicum autumnale)*. These examples demonstrate the valuable potential of plant-derived compounds in the discovery and development of modern therapeutic agents.[7]

India is well known for its rich plant diversity and long-standing tradition of using medicinal plants for healthcare. The Western Ghats, a UNESCO World Heritage Site and one of the world's important biodiversity regions, contains a wide variety of plant species with significant ethnomedicinal value. Within this region, the Konkan belt, covering the coastal areas of Maharashtra, Goa, and Karnataka, is particularly notable for its diverse medicinal flora. The region's lateritic soils, heavy monsoon rainfall, tropical climate, and high humidity create favourable conditions for the growth of numerous medicinal plants. Ethnobotanical studies carried out in areas such as Ratnagiri and Palghar have also highlighted the traditional use of indigenous plants for managing conditions associated with inflammation, wounds, and joint pain.[8] Likewise, ethnobotanical studies of mangrove ecosystems in the southern Konkan region have documented the traditional use of several plant species for managing health problems such as ulcers, rheumatism, and other inflammatory conditions.[9]

Despite the extensive traditional knowledge associated with medicinal plants of the Konkan region, scientific evidence supporting their anti-inflammatory properties is still scattered and incomplete. Available information comes from a combination of pharmacological studies, phytochemical investigations, and ethnobotanical reports. Although some plant species have been evaluated through *in vitro* and *in vivo* studies for mechanisms such as COX and LOX inhibition and suppression of the NF-κB pathway, several others have received little scientific attention beyond their traditional medicinal use. Moreover, a comprehensive review focusing specifically on the anti-inflammatory potential of plants found in the Konkan region is currently limited. This gap in knowledge may hinder the further

development, clinical evaluation, and conservation of these valuable medicinal resources.

The present review aims to address this gap by compiling information on 45 medicinal plants from the Konkan region with reported anti-inflammatory potential. A detailed tabular presentation is provided for each plant, covering its botanical family, scientific name, vernacular name, and traditional medicinal uses. The review further discusses their reported anti-inflammatory activities, major phytochemical constituents, possible mechanisms of action, and available pharmacological evidence. By bringing together traditional ethnomedicinal knowledge and findings from modern scientific studies, this review aims to highlight the therapeutic potential of Konkan medicinal plants, identify promising species for future drug-development research, and encourage further investigation into safe and effective plant-based approaches for managing inflammation.

Development of drugs incorporating medicinal plants

Traditional medicine continues to play an important role in healthcare systems around the world, with many communities relying on medicinal plants for the prevention and management of various health conditions. Ethnobotanical research has helped connect the traditional use of diverse plant species with their potential biological activities through systematic observation, documentation, and experimental investigation. This knowledge has contributed significantly to the identification and development of natural products with therapeutic potential. In recent years, plant-derived compounds have gained increasing attention in clinical and pharmacological research as potential sources for the treatment of several diseases. Among these natural compounds, polyphenols have attracted particular interest because of their ability to influence inflammatory processes and modulate different pathways involved in inflammation. [10]

Plants have long served as an important source of compounds for the discovery and development of new medicines, and many drugs currently used in healthcare are derived directly or indirectly from plant sources. Their rich diversity of secondary metabolites provides a valuable pool of biologically active compounds with potential therapeutic applications. This has increased interest in exploring plants for novel drug candidates, particularly because a large proportion of plant species remain insufficiently investigated for their chemical composition and biological activities. Consequently, medicinal plants continue to offer considerable opportunities for the identification of new and effective therapeutic agents.[11]

Table 1: Pharmacognostic Detailing of Plants with Anti-Inflammatory Potential

Common name	Botanical name	Family	Part used	Anti-inflammatory constituent	Uses
Nirgundi	*Vitex Negundo*	Lamiaceae	Leaves, roots, whole areal part	Iridoid glycosides, flavonoids, phenolic acids (e.g., negundo side)	Traditional use for arthritis, rheumatism, topical inflammation; extracts reduce edema and inflammatory markers in models.[12]
Behead	*Terminalia bellirica*	Combretaceae	Fruit, bark	Tannins, gallic acid, ellagic acid, flavonoids	Used in Ayurvedic formulations (astringent/anti-inflammatory); extracts show anti-inflammatory and antioxidant effects in reviews. [13]
Hirda	*Terminalia chebula*	Combretaceae	Fruit	Hydrolysable tannins (chebulinic acid, chebulagic acid, flavonoids	Broad traditional use for inflammation, evidence for antioxidant and anti-inflammatory activities summarized in reviews.[14]

Common name	Botanical name	Family	Part used	Anti-inflammatory constituent	Uses
Purnanava	*Boerhavia diffusa*	Nyctaginaceae	Roots, whole plant	Alkaloids, flavonoids, lignans (boeravinones)	Anti-inflammatory, hepatoprotective and immunomodulatory uses; reviews summarize *in-vivo and in-vitro* evidence.[15]
Gulvel	*Tinospora cordifolia*	Menispermaceae	Stems, leaves, roots	Alkaloids, diterpenoid lactones (tinosporaside), glycosides, steroids	Widely used as immunomodulator; many reviews highlight anti-inflammatory actions and cytokine modulation.[16]
Rui	*Calotropis procera*	Apocynaceae	Latex, leaves, root bark	Cardiac glycosides, flavonoids, triterpenoids	Latex/extracts show strong anti-inflammatory activity in animal models; systematic reviews summarize pharmacology and toxicology.[17]
Adulsa	*Adhatoda vasica*	Acanthacaeae	leaves	Alkaloids (vasicine, vasicinone)	Traditional remedy for respiratory inflammation; studies and reviews report anti-inflammatory and antioxidant actions.[18]
Bharangi	*Clerodendru m serratum*	Lamiaceae	Roots, leaves	Flavonoids, phenolics, sterols, terpenes	Used for pain and inflammation; review articles summarize anti-inflammatory and anti-arthritic evidence.[19]
Ashwagandha	*Withania somnifera*	Solanaceae	Roots	Withanolides (withaferin A, withanolide A), alkaloids	Strong body of reviews: anti-inflammatory, immunomodulatory and cytokine-modulating effects described.[20]
Ashoka	*Saraca asoca*	Fabaceae	Bark, Flower, seed	Flavonoids, tannins, glycosides	Traditional gynecological and anti-inflammatory uses; recent reviews summarize phytochemistry and anti-inflammatory studies.[21]
Bel	*Aegle marmelos*	Rutaceae	Leaves, fruit, root bark	Coumarins, marmelosin, furano-coumarins, tannins	Review reports anti-inflammatory, analgesics and antioxidant effects in traditional and experimental studies. [22]
Dhatura	*Datura spp.*	Solanaceae	Leaves, seeds, roots	ropane alkaloids (hyoscyamine, scopolamine), withanolide-like compounds in some spp	Some experimental evidence for anti-inflammatory/ analgesic effects but safety/toxicity is a major concern; reviews cover both activity and toxicity.[23]
Shatawari	*Asparagus racemosus*	Asparagaceae	Roots	Steroidal saponins (shatavarins), flavonoids	Reviews show anti-inflammatory and adaptogenic actions; root extracts reported to reduce inflammatory cytokines in models.[24]
Tridax	*Tridax procumbens*	Asteraceae	Leaves	Flavonoids, glycosides, triterpenoids	Traditionally used for wound healing and inflammation; reviews summarize anti-inflammatory and wound-healing evidence.[25]

Common name	Botanical name	Family	Part used	Anti-inflammatory constituent	Uses
Kokam	*Garcinia indica*	Clusiaceae (Guttiferae)	Fruit rind	Benzo-phenones (garcinol), xanthones, antho-cyanins	Garcinol and other constituents have anti-inflammatory effects; pharmacological reviews cover antioxidant/anti-inflammatory potential.[26]
Durva	*Cynodon dactylon*	Poaceae	Whole plant, roots	Flavonoids, phenolics, steroids	Reviews and studies report anti-inflammatory, wound-healing and antioxidant activities; used traditionally for inflammation.[27]
Tulsi	*Ocimum sanctum*	Lamiaceae	Leaves	Eugenol, ursolic acid, rosmarinic acid, flavonoids	Multiple systematic reviews: clinical and preclinical evidence for anti-inflammatory, immunomodulatory effects.[28]
Aloe vera	*Aloe vera*	Asphodelaceae	Gel, latex	Poly-saccharides (acemannan), C-glucosyl chromone, anthra-quinones	Reviews document inhibition of COX/PGE2, LOX and promotion of wound healing — clear anti-inflammatory activity summarized.[29]
Turmeric	*Curcuma longa*	Zingiberaceae	Rhizo-me	Curcuminoids (curcumin, dimethoxy-curcumin)	Extensive reviews/meta-analyses: curcumin reduces inflammatory mediators (NF-κB, cytokines) — widely studied as anti-inflammatory.[30]
Neem	*Azadirachta indica*	Meliaceae	Leaves, seeds, oil	Triterpenoids (nimbolide, nimbin), limonoids	Large body of reviews: anti-inflammatory, anti-microbial ,immune modulatory actions nimbolide often cited.[31]
Karonda	*Carissa carandas*	Apocynaceae	Fruits, leaves	Flavonoids, phenolic acids, anthocyanins, tannins	Anti-inflammatory, antioxidant; used in folk medicine for inflammation. Methanolic fruit extracts reduce edema in animal models.[32]
Eranda	*Ricinus communis*	Euphorbiaceae	Leaves, roots, seed oil (note: toxicity in seeds)	Ricinoleic acid, phenolics, flavonoids	Leaves and oil show anti-inflammatory, analgesic, wound-healing effects. Seeds have toxic ricin—care required.[33]
Jaswand	*Hibiscus rosa-sinensis*	Malvaceae	Flowers, leaves, roots	Anthocyanins, flavonoids, phenolic acids, saponins	Used for skin inflammation, wounds, general anti-inflammatory and analgesic activity; extracts reduce inflammatory markers in trials.[34]
Dhane	*Coriandrum sativum*	Apiaceae	Seeds, leaves	Linalool, flavonoids, phenolic compounds	Anti-inflammatory, digestive, antioxidant; seed and leaf extracts reduce swelling and inflammatory markers in animal/in-vitro studies.[35]
Nagkesar	*Mesua ferrea L*	Clusiaceae	Flowers, bark, seeds	Coumarins, xanthones, phenolics, diterpenoids	Traditional use for pain, arthritis and inflammatory conditions; studies show flower/bark extracts reduce inflammatory markers and edema.[36]

Common name	Botanical name	Family	Part used	Anti-inflammatory constituent	Uses
Karanj	*Pongamia pinnata*	Fabaceae	Seed (oil), leaves, bark	Flavonoids, rotenoids, pongamol, karanjin, phenolics	Seed oil/leaf extracts used topically/ orally for inflammation; multiple reviews document anti-inflammatory and antioxidant activity (mechanisms: COX/LOX inhibition, antioxidant scavenging) [37]
Kantola	*Momordica dioica Roxb*	Cucurbitaceae	Fruit, leaves	Saponins, flavonoids, triterpenoids, phenolics	Ethnobotanical and pharmacological reviews report analgesic and anti-inflammatory effects of fruit/ leaf extracts and antioxidant activity. Ethnobotanical and pharmacological reviews report analgesic and anti-inflammatory effects of fruit/ leaf extracts and antioxidant activity.[38]
Apta	*Bauhinia racemosa Lam*	Fabaceae	Bark, leaves, stem	Triterpenoids (β-amyrin), sterols (β-sitosterol), flavonoids, tannins	Used in Ayurveda for pain/inflammation; contemporary reviews and COX-inhibition studies.[39]
Parijat	*Nyctanthes arbor-tristis L*	Oleaceae	Leaves, flowers, bark	Iridoid glycosides, phenolics, flavonoids, nyctanthic acid	Traditional remedy for rheumatism/arthritis.[40]
Aamla	*Amla (Indian gooseberry) | Phyllanthus emblica L. (Emblica officinalis)*	Phyllanthaceae	Fruit, leaves	High vitamin C, tannins, gallic/ellagic acids, flavonoids, poly-saccharides	used in arthritis, inflammatory disorders and as a rasayana in Ayurveda.[41]
Henna	*Lawsonia i nermis L*	Lythraceae	Leaves	tannins, flavonoids	Traditional topical uses (wound healing, dermatitis); reviews document in-vitro and in-vivo anti-inflammatory effects[42]
Mango	*Mangifera indica L*	Anacardiaceae	Leaves	Mangiferin, quercetin, gallic acid, other polyphenols	used traditionally for inflammatory and gastric disorders.[43]
Lavang	*Syzygium aromaticum*	Myrtaceae	Dried flower buds	Eugenol (major), eugenyl acetate, β-caryophyllene, other phenolics	Eugenol shows potent anti-inflammatory and analgesic effects (COX/LOX inhibition, cytokine suppression).[44]
Ginger	*Zingiber Officinale Roscoe*	Zingiberaceae	Rhizome	Gingerols (6-gingerol), shogaols, zingerone, paradols	used clinically for arthritic pain and inflammation adjunctively.[45]
Suran	*Amorph-ophallus paeoniifolius (Dennst.) Nicolson*	Araceae	Tuber	Betulinic acid, β-sitosterol, glucomannan, tannins	Traditional use for inflammatory bowel complaints, haemorrhoids and pain; tuber extracts show anti-inflammatory and antioxidant activity in animal. [46]

Common name	Botanical name	Family	Part used	Anti-inflammatory constituent	Uses
Jambul / Jamun	*Syzygium cumini (L.) Skeels*	Myrtaceae	Seeds, fruit, leaves, bark	Anthocyanins, ellagic acid, quercetin, kaempferol, other phenolics	Traditional use for anti-inflammatory, antioxidant and antidiabetic effects. [47]
Shevga (Drumstick)	*Moringa oleifera Lam*	Moringaceae	Leaves, pods, seeds	Quercetin, kaempferol, isothiocyanates, niazimicin	Powerful antioxidant and anti-inflammatory activity; leaf extracts reduce cytokines and oxidative stress in many studies.[48]
Kurdu (Shitivar)	*Celosia argentea*	Amaranthaceae	Bark, seeds	Alkaloids (conessine), steroidal compounds	Traditional use for gastrointestinal and inflammatory disorder; alkaloids show biological activity including anti-inflammatory effect. [49]
Pipal	*Ficus religiosa L.*	Moraceae	Leaves, latex, bark	Flavonoids, tannins, sterols, saponins, phenolics	Leaf extracts show analgesic and anti-inflammatory activity in animal models and in vitro fractions; traditional use for inflammatory conditions.[50]
Takla	*Cassia Obtusifolia*	Leguminasoea	Leaves, seeds Anthra quinones	flavonoids, glycosides, phenolics	Leaves/seeds show antioxidant and anti-inflammatory activity in in-vitro assays; ethnomedicinal use as anti-inflammatory/skin remedy.[51]
Alu	*Colocasia esculenta (L.) Schott*	Araceae	Leaves, corms	Flavonoids, triterpenoids, polysaccharides, phenolics	Multiple reports/reviews describe antioxidant and anti-inflammatory effects (in vitro and some in vivo), traditional use for arthritis and inflammatory complaints.[52]
Somvel	*Sarcostemma acidum*	Apocynaceae	Whole plant (resins)	Flavonoids, saponins, glycosides, steroids, triterpenoids	Ethnomedicinally used for inflammatory complaints; in-vitro and membrane-stabilization (HRBC) and other assays report anti-inflammatory activity.[53]
Bhalvand	*Cassia fistula L.*	Fabaceae	Pods (pulp), bark, leaves, flowers	Anthraquinones, glycosides, flavonoids, tannins, phenolics	Well-documented antioxidant and anti-inflammatory activity in multiple studies (bark and pulp extracts); widely used traditionally for inflammatory and wound conditions.[54]
Kukrda	*Sterculia/ "kukar"*	Sterculiaceae	Seeds /flowers /leaves (depends on species)	fatty oils, sterols; Celosia: flavonoids, saponins, phenolics	Where identified as Celosia argentea, experimental studies report anti-inflammatory and antioxidant activity.[55]
Sharphunkha	*Tephrosia purpurea (L.) Pers.*	Fabaceae	Leaves, roots, whole plant	Flavonoids (e.g., tephrosin), rotenoids, phenolics, saponins, alkaloids	extracts (root/leaf) show significant anti-inflammatory and wound-healing effects in animal models.[56]

Phytoconstituents found in Kokan region plants having anti-inflammatory potential and their mechanism of action:

Substances of plant origin, belonging to the most diverse chemical classes, have already demonstrated proven anti-inflammatory activity. Among them, alkaloids, terpenes, and phenolic compounds such as tannins, lignans, coumarins, saponins, and especially the flavonoids stand out.[57]The structural variation in ring C subdivides flavonoids into six main subclasses: flavanols (e.g., quercetin, kaempferol, myricetin), flavones (e.g., luteolin, apigenin), flavanols (e.g., catechin), flavanones (e.g., hesperidin), anthocyanidins (e.g., cyanidin, pelargonidin), and isoflavones (e.g., genistein, daidzein) [59]

Flavonoids have an anti-inflammatory capacity since they inhibit the production of inflammatory mediators by modulating the arachidonic acid pathway, inhibiting several enzymes such as ATPase, prostaglandin, cyclooxygenase, lipoxygenase, NADH oxidase, protein kinase, hydrolases, peroxidases, metallopeptidases, tyrosinases, and phospholipases. Thus, flavonoids have been the target of increasing interest as a potential therapeutic drug in inhibiting or even decreasing inflammatory activity[60]

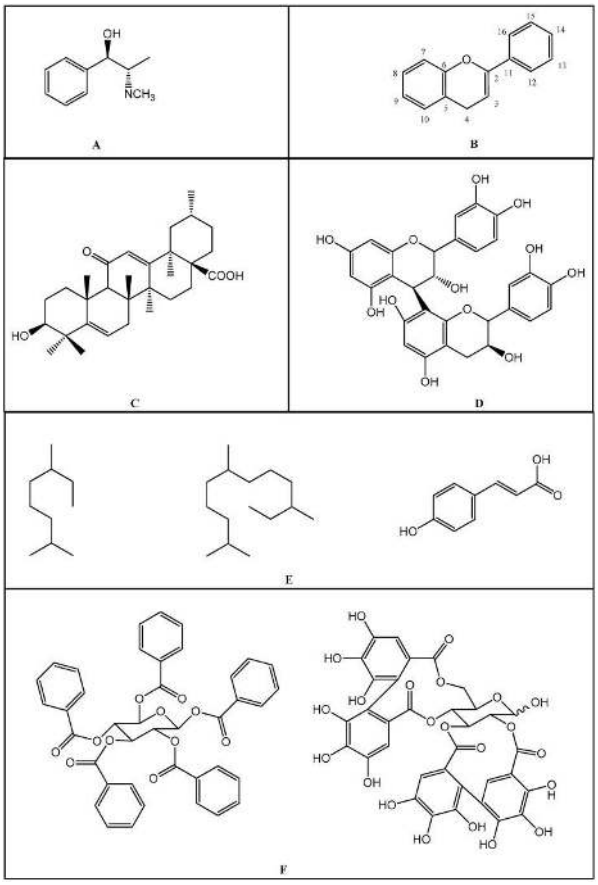


Figure 1: Plant Constituents a: Alkaloids: Ephedrine. B: Basic Flavonoid C: Saponins: Glycyrrhizin, D: Condensed Tannin, E: Terpenoids and Phenylpropanoids, F: Hydrolysable Tannins: Galo Tannins and Ellagitannins[58]

Although an expressive number of flavonoids are present in plants in the form of glycosides, consignments about the biological activities of flavonoids have been made mainly for aglycones. Some research on the structure-activity relationship and the inhibition of inflammatory mediators can also be found in the scientific literature. It has been reported that the presence of hydroxylation at the 3′ and 4′ positions of the B ring of the flavonoid structure enhances the modulatory action on the inhibitory activity of TNF-α, while the presence of only one hydroxyl minimizes inhibition and the absence of this group overrides the inhibitory

effect. To inhibit iNOS or nitric oxide (NO) production, the presence of at least three hydroxyls is required. This is the case of luteolin and its derivatives that have a catecholic pattern of oxygenation in ring B and also oxygenations in ring A. Oxygenation at position 5 of ring A contributes significantly to anti-inflammatory activity.[61]

The anti-inflammatory potential of 9 flavonoid aglycones was evaluated: kaempferol, quercetin, apigenin, chrysin, diosmetin, luteolin, daidzein, genistein, and hesperidin. Among them, luteolin was the most active in the inhibition of NO and TNF-α.[62]

Impact of plant composition on anti-inflammatory response - Plant composition varies depending on various factors like:

1. Genetic differences — Many medicinal species exist as multiple chemotypes (different dominant secondary-metabolite profiles) even within a species; chemotypes can show markedly different bioactivities, including anti-inflammatory potency. Studies of essential-oil-bearing and other medicinal plants repeatedly document chemo typic variation and its functional consequences.[63]
2. Geographic /climatic effects on plant composition — Soil type, altitude, rainfall and microclimate (all relevant across distinct Konkan microhabitats) influence secondary-metabolite levels and proportions, producing population-level differences in activity. Several recent case studies show geographic variation driving differences in anti-inflammatory and antioxidant outcomes.
3. Season and phenological stage can change both yield and potency in anti-inflammatory assays. Concentrations of flavonoids, phenolics, terpenes and other actives fluctuate with season and with plant developmental stage (pre-flowering vs. flowering vs. fruiting). Harvest timing is very important. [64]
4. Plant part and ontogeny — Leaves, stems, roots, bark and flowers often have different metabolite profiles; activity measured from one part cannot be extrapolated to another. Within Konkan plants, traditional uses often specify parts —for modern assays.[65]
5. Post-harvest handling & drying — Drying method, temperature, and storage alter labile compounds (volatile terpenes, some phenolics), affecting extract composition and *in vitro/in vivo* effects. Proper documentation of post-harvest steps are essential. [66]
6. Extraction method and solvent polarity — Solvent choice, extraction time/temperature, and concentration method strongly determine which classes of compounds are extracted (polar phenolics vs. lipophilic terpenoids) — and thus the anti-inflammatory profile also varies. Comparative reviews show the same plant can produce extracts with different mechanisms and potencies depending on method.[67]
7. Genotype and environment interactions — Genetic background interacts with environment; cultivation (fertilizer, irrigation) vs wild collection often yields predictable shifts in metabolite content. This matters when recommending sustainable sourcing or cultivation for standardization.[68]

A comparison between traditional vs. modern use of medicinal plants in therapy - can be seen as evolution from empirical observation to precision execution.

- Traditional / ethnomedicinal use — uses whole plant parts or simple preparations (decoctions, poultices, oils, pastes) chosen by symptom and local knowledge; multi-constituent mixtures are applied systemically or topically and selected empirically over generations. (local names, uses, preparations).[65] Whereas, modern scientific approaches range from bioassay-guided fractionation and isolation of single active molecules, to untargeted metabolomics, mechanism-focused cellular/animal models, formulation science (including nano formulations), and tightly controlled clinical trials. Modern work aims to identify molecular targets, ADME/tox profiles, and scalable, standardized preparations.[66]
- Multi-component vs Target-focused mechanisms - Traditional preparations often act through multiple mechanisms (antioxidant, cytokine modulation, enzyme inhibition) because they contain multiple components that act additively or synergistically.

This polypharmacology can be therapeutically useful but complicates mechanistic attribution.[65] Modern techniques isolate specific phytochemicals (flavonoids, terpenoids, alkaloids) and test them on defined molecular pathways (NF-κB, MAPK, COX/LOX, iNOS). This clarifies mechanism but may miss beneficial mixture effects.[65]

Reproducibility & standardization - Traditional methods suffer from variability (chemotype, season, harvest/processing), so efficacy is often inconsistent across locations and studies. Modern pipelines emphasize chemotyping (HPTLC/UPLC/GC-MS), marker compounds, and standardized extraction — improving reproducibility and enabling regulatory pathways.[67]

- Delivery & bioavailability - Traditional delivery (oral decoction, topical) sometimes limits systemic exposure as many plant actives are poorly soluble or unstable. Modern formulation science (phytosomes, nanoemulsions, metal/biopolymer nanoparticles) improves solubility, protects labile compounds, and can increase efficacy and reduce dose-related toxicity. Several recent reports show nanotechnology markedly improves anti-inflammatory performance in preclinical studies.
- Safety and toxicology - Traditional long-term use suggests safety for many species but does not replace systematic toxicology. Adverse effects, herb –drug interactions, and batch-to-batch contaminations require modern ADME/tox testing. Modern research increasingly pairs efficacy work with OECD-style toxicity screens and genotoxicity/interaction studies.[65]
- Strengths of plant-based (traditional)- include culturally accepted, low cost, multi-target action, local availability, whereas the limitations are variability, uncertain dosing, limited clinical-grade safety data. [69] Strengths of modern approaches involve reproducible chemistry, clear mechanism, scalable formulation, regulatory path but they do have certain limitations like isolating single molecules may lose mixture benefits, higher development cost and time, potential IP and other regulatory complexity.[66]

Many plant medicines have preclinical support (*in vitro*, animal models) but have not undergone high-quality clinical trials. However, systematic analysis increasingly find benefit for certain botanicals (examples: chamomile and some topical/herbal agents in oral mucositis/gingivitis and other inflammatory conditions), supporting potential clinical roles as adjuncts or alternatives in selected indications. Overall, plant-based treatments are widely used worldwide—both in traditional systems and as complementary therapies in modern practice—but high-quality Randomized Controlled Trial evidence remains limited for most species. [68]

Global surveys and reviews show extensive use of herbal therapies as primary or complementary anti-inflammatory treatments in many regions; use ranges from topical traditional therapies in rural settings to standardized botanical products used as over-the-counter nutraceuticals. Clinical evidence is growing but still concentrated on a handful of well-studied herbs; most taxa remain at the preclinical stage. Systematic reviews (recent examples) show positive signals for selected botanicals in specific conditions (e.g., chamomile for mucositis/gingivitis), but call for larger, better-designed Randomized led Trials. [68]

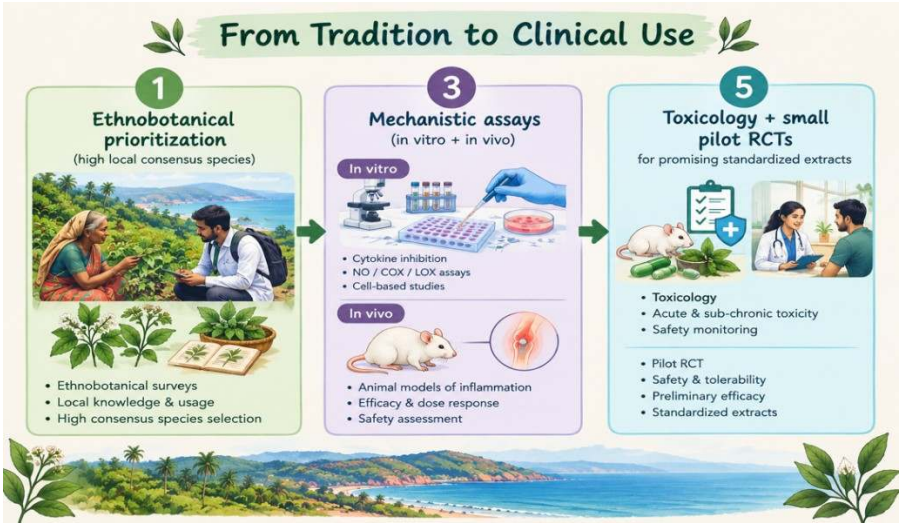


Figure 2: From Traditional to Clinical Use of Plants

CONCLUSION

The Konkan region of India, with its unique geographic and climatic conditions, is a hotspot of plant biodiversity, particularly rich in species with medicinal properties. This review has explored the taxonomy of various anti-inflammatory plants native to this region, highlighting their traditional uses, scientific classifications, and potential for therapeutic applications. Many of these species, such as (*Curcuma longa)*, (*Zingiber officinale*), (*Ocimum sanctum)*, and (*Terminalia chebula*,) have been used for centuries by indigenous communities to treat inflammation and related ailments.

Taxonomic study plays a crucial role in accurately identifying and classifying these plants, which is fundamental for ensuring consistency in research, pharmacological evaluation, and conservation efforts. Through taxonomic clarity, researchers and healthcare professionals can better understand the bioactive compounds responsible for anti-inflammatory effects and develop standardized herbal formulations. Additionally, documenting the traditional knowledge associated with these plants is vital for cultural preservation and for guiding scientific inquiry. However, with increasing threats from deforestation, urbanization, and climate change, there is an urgent need to implement strategies for the conservation and sustainable use of these medicinal plant resources.

In conclusion, the Konkan region represents a valuable repository of anti-inflammatory medicinal plants. Future efforts should focus on integrating traditional knowledge with modern scientific methods, promoting in-depth pharmacological studies, and supporting conservation initiatives to ensure that this rich botanical heritage continues to benefit both local communities and global healthcare.

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